

jasper, one side of which is left untouched, while the other is all chipped away except a small central area; most of them are unfinished. The few implements found among the quartz chips are very rough, and may be classed as lance-heads. The smaller pebbles of agate and carnelian seem to have been broken up in great numbers to obtain, out of the interior flakes, small articles about the length of the thumb-nail, of two types, pointed and rounded.

There is one doubly-pointed arrow head of jasper carefully finished like Fig. 299 in Evans's "Stone Implements." Also several rough implements of larger size of impure basalt. Many of the hammer-stones are very characteristic, and have been much used. Others show the effect of attrition by sand, &c., as in those from the Irish sand-hills.

F. ARCHER

Crosby, Liverpool, January 30

Wady Halfa, January 2, 1886

SIR,—When serving in the Soudan last winter, in the occasional walks I was able to take in the Desert I kept a look out for stone implements, but failed to find any until I reached Abri, where I picked up on the beach a well-worked flake, but much worn, of Egyptian jasper.

Shortly after my arrival here I found several scrapers in the plain lying between the river and the hills, and more extended search led me to further discoveries. The hills at Wady Halfa, which are of sandstone capped with trap (?), are distant about a mile and a half from the present banks of the river, but at a bend of the Nile about eight miles below our camp the valley narrows, and the cliffs rise almost perpendicularly from the water's edge. To the south it widens to the extent of some six or eight miles between the hills on either bank. The whole of the plain between the sandstone ridges is covered with a deposit of Nile mud of unknown depth, but on the right bank this is to a great extent concealed by the sand and pebbles brought down in past ages by the river. The ground is uneven, here and there rising to mounds of hardened mud. There is, however, a gradual though slight rise towards the hills. Soon after my arrival I picked up a number of flakes of quartz, and found that they were most numerous in a belt of dried mud about half a mile distant from the river and a quarter of a mile in width, and tracing this northward I found a mound, some acres in extent, formed of mud and completely covered with sand and tons of chips of quartz, and also of agate, onyx, carnelian, and other hard stones. It was evidently the site of an ancient manufactory, and on this spot, in the many visits I have since paid to it, I have got numerous more or less well-fashioned specimens. Stone hammers may be picked up by the dozen, and these are made of many different minerals. The most interesting are those formed of silicified wood, of which large blocks, curiously polished by the action of the water and sand, are still lying on the river's bank. Tracing the belt further, I have found, both north and south of the camp for many miles, chips and hammers more or less abundant, and little water-worn. I have reason to think that the same is the case on the left bank.

Rambles in the desert, and search among the debris brought down by the Nile in former times were rewarded by the discovery of many roughly-worked flakes, evidently of much earlier date, being very much water-worn. These were widely scattered over the desert, being nowhere abundant. The highest point at which I found them was on the summit of a gravel-covered mound about 50 feet above the present level of the river.

A proof of the Nile having in former times flowed at a much higher level than it does at present, is found in the fact that valves of the peculiar Nile bivalve, *Aetheria*, may still be seen attached to the rock close to the foot of the hills, and at an elevation of some 30 feet above the present bank. As this shell must necessarily have lived always under water, the rocks when they are found must formerly have been part of the river-bed. If then as now the difference in height between high and low Nile amounted to 40 feet, it is evident that when the shells were living the stream flowed 60 to 70 feet higher than it now does. Whether the stream has receded or the land been elevated I am unable to decide.

It is stated in Murray's Handbook—I know not on what authority—that there is an inscription at Sannek, 35 miles south of Wady Halfa, which records that in the reign of Amenanhat III. of the twelfth dynasty, the Nile at that place rose to a point 27 feet 3 inches higher than it does at the present time. If this is the case and if the same were true as regards the river at this place, the implements and chips found in the belt previously

mentioned are of a date subsequent to the reign of that king. I have found some hammers and flakes in the plain not far from the Nile, and very little above its present level.

If any traveller is desirous of obtaining specimens from this neighbourhood he will find a landmark in the British Military Cemetery, from which point the strip of desert in which the remains are most abundant may be traced north or south. The mound of chips is about a mile to the north of the graveyard overlooking an ancient water-course.

S. ARCHER

P.S.—Since writing the above I have found another small mound with quartz flakes only between the Nile and the railway.

Parallel Roads in Norway

PARALLEL roads in Norway, such as those described by Mr. Hansen in your last number (p. 268), have already attracted the attention of several British geologists. Robert Chambers, a careful observer, saw and described them as long ago as 1849. His description, however (*Edinburgh Philosophical Journal*, vol. xviii. p. 71), seems to be unknown abroad, and is not generally accessible anywhere. With your leave, therefore, I quote it entire.

"The valley of the Laugen, for several miles down, contains great masses of pure sand in the form of terraces and isolated mounts. On one of the latter Dovre Church is situated. . . . In this portion of the valley there is a terrace unlike the rest, in as far as it is a narrow ledge of detrital matter, running continuously along the hill-side for fully fourteen miles, however much more, while the terraces resting on the skirts of the hills lower down are great projecting masses, seldom extending far on one level. This remarkable terrace is most conspicuous on the south-west side of the valley. It begins on that side at Oue, between the Hogen and Tofte post-stations. It is there seen truncating the prominent ancient delta of a side stream, called, in Prof. Munch's map, the Jondals Elv, several hundred feet above the bottom of the valley. As we ascend the valley, it becomes nearer to our eye, but this is only because we rise to it, for, when examined with a correct instrument from its own elevation on the opposite side, it is proved to be for a great way truly horizontal. On the north-east side of the valley the corresponding mark is a line composed of slight projecting banks of water-laid sand. Though not continuous, this line is sufficient to have determined that of a long mountain-path connecting a series of farms. Beyond Lie post-station the road to Molde passes along it, and it here affords positions for a close series of hamlets, which make a conspicuous appearance in the map above cited. I believe it is nearly, if not exactly, of the same elevation with the little *hof*, called Dombaas, of which the height is given by Prof. Naumann as 2162 (English) feet. In its relation to the lakes in the summit between the two valleys (*i.e.* of Laugen and Raum) it precisely resembles the lowest of the Inverness-shire *parallel roads*, as exemplified in Glen Spean, where advancing to the basin of Loch Laggan, between the Spean and Spey valleys. The terrace in every other respect bears a strong resemblance to the Inverness-shire *roads*, while in some important respects, as already noted, it differs from other terraces. I should much desire to see it obtain the attention of local observers, by whom its internal constitution and other features could be more particularly ascertained."

I offer this extract the more readily that the observations of the paper in which the passage occurs ("On Changes in the Relative Level of Sea and Land in Scandinavia") have scarcely received the attention, among Norwegian geologists, to which their care entitles them. Chambers further refers to the same terrace, in a descriptive and popular way, in his "Tracings in the North of Europe," a little volume reprinted (for distribution, fifty copies only) from *Chamber's Journal* in 1850. You will perhaps allow me to add this short reference to the other.

"In addition to the many sandy terraces at different and indeterminate heights, I discovered one of a much more remarkable character, passing along both sides of the valley for fully twenty miles, always at one elevation, and specifically identical as a terrace with the celebrated *roads* of Glenroy in Inverness-shire. It first became visible at a place called Oue (pronounced Ouya) on the west side of the valley, where it truncates the ancient delta of a side stream far up the mountain-side. It is seen thence passing along through the scraggy woods without any interruption, till, on our turning out of the valley, we lose sight of it among the high grounds near Lässö Lake.

On the east side of the valley, perhaps 150 feet above the level of the road at Lie Station, I could distinctly trace this terrace by its hummocks of water-laid sand, and the farmhouses perched on its favourable points. A long series of hamlets on the road to Molde is placed upon it. As an object in physical geography, in its form, its uniform level on both sides of the vale, and its relation to the lakes at the summit-level, this terrace precisely resembles the lowest of the Glenroy terraces as it approaches Loch Laggan. It must, however, be more than twice the level above the sea" (p. 105). Chambers, of course, viewed it as an ancient sea-margin.

The same long terrace was also seen by my colleague, Mr. J. R. Dakyns, in 1872, and described (without reference to Chambers) in the *Geological Magazine*, 1877, p. 74. "If the terrace is on a level," he says, "with the watershed, and there is certainly no great difference between them, one is irresistibly led to think of the similar case of the parallel roads of Glenroy, and . . . of a gigantic Marjelen See dammed back by ice till it overflowed the summit of the pass at Molmen. It is significant that I could see no trace of terrace or water-mark on the Romsdal side of the pass. There is in the same district a second horizontal mark on the solid rock, several hundred feet higher than the 2000-foot one. This, too, seems to correspond with sand-terraces in the recesses of the high glens. . . . Here again it is striking that the water-mark should seem to correspond with the level of a watershed."

I myself saw Chambers's striking terrace in 1873. But I have nothing to add to the observations above quoted, and I make no claim whatever to have my name connected with them. But I may remark the fact that the little deltas or alluvial cones of the streams, where these cross the terraces, so conspicuously bear reference to the surface of the vanished sheet of water in which they were formed, as to remind one how greatly similar evidence was relied on by Darwin as demonstrating the *aqueous* origin of the roads of Glenroy. Mr. Hansen's discovery of parallel roads at the head of the Glommen and in Jemtland is very interesting, and I hope he will find time to study and *map* them in detail.

HUGH MILLER

51, Lauriston Place, Edinburgh, January 24

Meteorological Phenomena

ON January 4 last, while watching a very bright rainbow with a good secondary from Hoylake racecourse, I observed between the two bows a third, fainter than either, touching the primary at the base and extending upwards in such a way that probably, had it all been visible, it would have touched the secondary at the vertex. It was not all visible because of a break in the clouds. Its colours were in the same order as those of the primary, red outside. This third bow was only visible at one side; but a gentleman who observed it stated that he had seen it before, and symmetrical on both sides, though not extending to the vertex.

Another phenomenon I have observed here some time ago. A fall of hail lasting a few minutes occurred, the hailstones being exact cubes, of size about 7 mm. and of consistency like lumps of salt.

JOHN C. WILLIS

University College, Liverpool, February 1

M BARRÉ DE SAINT-VENANT

"WE have now to consider the earlier work of the greatest of living elasticians." Within a fortnight after these words were sent to the press, on January 6, M. de Saint-Venant died at Vendôme. The news of his death will have caused a deep feeling of regret among English mathematicians and physicists, to whom his researches are so well known that they have attained in their own field a classical value. We purpose in this notice to give some brief account of this foremost representative of latter-day French mathematical physicists.

Saint-Venant stood out for the younger mathematicians of the English school, as the link between the past and the present. Intimately related to the great period of French mathematical physics, he had continued to produce down to our own day, and we felt him to be as real a personality as Helmholtz or Thom-

son. A younger member of the school of Poisson, Navier, and Cauchy, he had yet lived to "edit" Clebsch. Deputy for Coriolis at the École des Ponts et Chaussées in 1837, Saint-Venant early received public recognition for his work from Poncelet in his lectures at the Sorbonne in 1840; within the next few years he corrected Cauchy's theory of torsion, and saw his correction accepted by the author of the "Exercices des mathématiques." More than forty years afterwards he "edits" what will long remain the standard treatise on elasticity—the annotated French translation of Clebsch. Thus his work is spread without a break across the middle fifty years of our century; he took up elasticity where Poisson had left it—a mathematical theory; he leaves it one of the most powerful branches of mathematics applied to physics and practical engineering; not a small amount of this transformation is due directly to his researches, or indirectly to his influence.

Turning to the personal character of the man, we find in him the essential characteristics of the scholar and the student, the truest modesty, the complete absence of self, the single-minded devotion to his study. Saint-Venant, whose researches on elasticity undoubtedly far surpass those of Navier and Clebsch, is yet content to appear as their *editor*. But what an editing it is! The original text is hidden, disappears, almost as completely as Peter the Lombard's "Sententia" in a mediæval commentary. It is Saint-Venant's notes, appendices, and corrections, which form the value of these works, which make the third edition of Navier's "Leçons" the standard treatise on the strength of materials, and the French translation of Clebsch the foremost work on mathematical elasticity. Nay, he even praises Clebsch for inventing a term in 1862, which he himself had first proposed in the privately distributed lithographed sheets of 1837! Ever ready with advice and assistance, perfectly free from jealousy, Saint-Venant was a typical scholar. We had occasion, scarcely six months ago, to apply to him for assistance with regard to some of his earlier work. Within a few days we received a packet containing twenty-three of his memoirs, all carefully corrected, and many annotated. He expressed a lively interest in the progress of the "History of the Mathematical Theories of Elasticity," lending the editor of that work several French lithographed courses which were otherwise inaccessible, and accompanying them by letters which amounted almost to a dissertation on the history of elasticity.

"Je desire, bien cher monsieur, que ces quelques renseignements et documents puissent servir à l'utile travail historique que vous avez entrepris, et dont j'apprendrai avec plaisir la publication ainsi que le nom de l'éditeur. J'en verrais même avec plaisir les épreuves."

Shortly before Christmas we received from Saint-Venant corrections for the first three sheets of Dr. Todhunter's ninth chapter, which is devoted to Saint-Venant's earlier work. On January 3 we sent him the remaining proofs of that chapter; a week afterwards we had to mourn the loss of one whose personal kindness had served to intensify the respect raised by his transcendent mathematical ability.

If we examine the leading characteristics of Saint-Venant's scientific work we find them marked by an essentially practical character. We find subtlety of analysis combined always with practical physical conceptions. The problems he attacks are those which are physically possible, or of which the solution is an immediate practical need. He smiles good-naturedly over Lamé's attempts to solve the terrible problem of an elastic solid in the form of a right-six-face, whose surface is subjected to any system of load. The solution would be a triumph of analysis, but its physical and practical value would in all probability be *nil*. He chooses instead a *real* beam, and he obtains a solution which, if it be but approximate, is at least an approximation to reality, and will serve all practical purposes. Saint-Venant never